

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C.

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In the Matter of) IB Docket No. 95-91
) GEN Docket No. 90-357
Establishment of Rules and Policies for the)
Digital Audio Radio Satellite Service in the)
2310-2360 MHZ Frequency Band)

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CONSOLIDATED REPLY OF XM RADIO INC.

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Summary

With the U.S. satellite DARS systems scheduled to begin providing service to the public a little more than a year from now, XM Radio opposes the last-minute efforts of the wireless cable industry to impose additional and unnecessary costs on the DARS operators that will hamper the efficiency of DARS repeater networks and possibly delay the introduction of high-quality service.

In 1997, when the FCC took comments on DARS repeater deployment and again in 1998 when XM Radio and Sirius Radio filed information with the Commission describing the likely number and power levels of their repeaters, the wireless cable industry was silent as to the need for any limitations on DARS repeaters. Only now, with the filing of this supplemental information, which is consistent with the earlier filings, does the wireless cable industry complain that limitations must be placed on DARS repeaters. The Commission should reject such dilatory requests for protection.

Moreover, the requests are without merit. There will be no interference to wireless cable customers using newer equipment. These appear to represent the vast majority of wireless cable customers, particularly since the deployment of PCS appears to have stimulated the change-out of old equipment for new, less interference-sensitive equipment. Very few of the remaining customers who use older block downconverters will be affected, since most of these users will be sufficiently distant from the repeater or their antennas will be pointed at a different location than the repeater site.

XM Radio is not opposed to the request of NAB that DARS licensees provide information to the Commission concerning the location of their repeaters. XM opposes, however, any requirement that there be a prior approval process for repeater or a process of

providing prior notice to WCS or other system operators. As long as the DARS operators comply with appropriate operational limits, such additional, time-consuming procedures would be unreasonable.

Table of Contents

	Page
Summary	i
Background	1
Discussion	7
I. XM is willing to accept a requirement that it notify the FCC of repeater locations, but no prior coordination should be required	7
II. WCA and BellSouth have failed to present sufficient evidence to justify the imposition of their proposed rules and restrictions on DARS licensees at this late date	8
A. The Commission's decision to adopt power limits in the WCS proceeding is irrelevant to the DARS repeater rulemaking	8
B. The record in the WCS proceeding is now stale, given the events that have occurred since the close of that rulemaking	9
C. The Commission should not adopt a proposal presented at this late date in this rulemaking proceeding	11
III. The proposed power limits are unnecessary and would impose undue costs on XM Radio	12
A. There will be no significant interference from DARS repeaters	12
1. High-power DARS repeater transmissions are highly unlikely to cause interference to the new, more robust wireless cable receivers	12
2. XM Radio's repeaters are unlikely to interfere even with older MMDS and ITFS receivers	13
B. The proposed power limits would impose substantial costs on XM Radio	13

IV.	The Commission should not require DARS licensees to compensate MMDS/ITFS licensees	14
V.	BellSouth's request for a more stringent out-of-band emissions limit should be rejected	15
Conclusion		16

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CONSOLIDATED REPLY OF XM RADIO INC.

XM Radio, Inc. ("XM Radio") hereby replies to comments filed by the Wireless Communications Association International ("WCA"), BellSouth Corporation and BellSouth Wireless Cable (collectively, "BellSouth"), and the National Association of Broadcasters ("NAB") on XM Radio's Supplemental Comments ("Supplement") describing its planned operation of Digital Audio Radio Service ("DARS") terrestrial repeaters. As described in the Supplement, XM Radio since 1997 has made extraordinary progress in the development of its DARS system, and it currently expects to begin commercial service to subscribers by mid-2001, more than two years earlier than required under the Commission's milestones.

Now, almost three years after the main pleading round on repeater rules and more than two years after the two DARS licensees provided an initial description of their planned repeaters, WCA and BellSouth for the first time and without substantial evidence seek restrictions on DARS repeater operations, restrictions that would impose an unnecessary burden on DARS licensees and possibly delay the introduction of service.

Background

Earlier Commission Proceedings on DARS Repeaters. On March 3, 1997, the Commission released its Further Notice of Proposed Rulemaking on licensing and operational

rules for DARS terrestrial repeater facilities.^{1/} In its *FNPRM*, the Commission proposed to adopt a blanket licensing process that would require DARS operators to comply with the Commission's general rules on antenna structure clearance, environmental effects, and RF emissions. The Commission also proposed to prohibit DARS licensees from locally originating programming from their repeater facilities. Comments and replies were filed in June 1997. Neither WCA nor BellSouth submitted comments during that filing period.

In November 1997, XM Radio and Sirius Radio provided new information regarding their planned operation of terrestrial repeaters.^{2/} XM Radio stated that it planned to operate terrestrial repeaters at an EIRP of up to 10 kW, while Sirius Radio indicated that it expected to operate repeaters at EIRPs of 70 kW and higher. Comments and replies on those supplemental submissions were filed in December 1997 and January 1998, and once again neither WCA nor BellSouth submitted any filing.

XM Radio's Supplemental Comments. On December 17, 1999, XM Radio filed its Supplement with the Commission regarding the planned deployment of its DARS terrestrial repeaters.^{3/} As XM Radio has previously indicated, gap-filling terrestrial repeaters will facilitate the provision of a high-quality, multichannel radio service, providing a receivable XM Radio

^{1/} Report and Order Memorandum Opinion and Order and Further Notice of Proposed Rulemaking, Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band, 12 FCC Rcd 5754, paras. 138-142 (1997) ("*FNPRM*").

^{2/} See Letter from William Garner, Chief Scientist, American Mobile Radio Corporation, to Rosalee Chiara, Satellite Policy Branch, Federal Communications Commission, IB Docket No. 95-91 (November 14, 1997); Letter from Robert D. Briskman, Chief Technical Officer, CD Radio, to Rosalee Chiara, IB Docket No. 95-91 (November 14, 1997).

^{3/} Supplemental Comments of XM Radio Inc., IB Docket No. 95-91 (December 17, 1999) ("Supplement").

signal in those limited areas where it may be difficult to receive satellite-based signals due to line-of-sight blockage from buildings, and where the satellite signal receives interference from various terrestrial sources, such as microwave ovens. XM Radio intends to deploy and operate approximately 1500 terrestrial repeaters, within a 20 to 30 mile radius of the urban centers of the largest seventy metropolitan areas in the country. Supplement at 3.

As indicated in the Appendix A to the Supplement, "Technical Description of Planned Terrestrial Repeater Facilities," XM Radio plans to deploy four types of terrestrial repeater: standard; intermediate; high-power; and microrepeater. Supplement, Appendix A at 4. The majority of XM Radio's terrestrial facilities will be standard repeaters, which will typically have an EIRP of approximately 1 kW per carrier. XM Radio's intermediate repeater will typically have an EIRP of 2.5 kW per carrier. Most of XM Radio's approximately 150 high-power repeaters will have an EIRP ranging from 3 to 10 kW per carrier, while approximately twenty-five of these high-power repeaters will have an EIRP of 10 to 20 kW per carrier. XM Radio's microrepeaters will provide 1 to 10 watts of power into an omni-directional antenna. *Id.* at 4-5

In the Supplement, XM Radio indicated that, pursuant to an agreement with Sirius Satellite Radio Inc. ("Sirius Radio"), XM Radio's out-of band emissions will be attenuated below the transmitted EIRP ("p") (measured in watts) by not less than $75 + 10 \log (p)$ dB. Supplement at 5. In its Supplement, XM Radio expressed its continuing support for the licensing and operational rules proposed by the Commission for DARS terrestrial repeaters in March 1997, and urged the Commission to finalize its regulatory framework for terrestrial repeaters as soon as possible. *Id.* at 4, 5.

Sirius Radio's Supplemental Comments. On January 18, 2000, Sirius Radio, the DARS licensee in the 2320-2332.5 MHz frequency band, also filed Supplemental Comments describing

its planned DARS terrestrial repeaters.^{4/} Like XM Radio, Sirius Radio asked that the Commission expeditiously finalize rules for terrestrial repeaters, and presented a technical analysis supporting the conclusion that its repeaters would not cause interference to operators in any other communications service.

Comments of NAB, WCS, and BellSouth. For its part, NAB commends XM Radio and Sirius Radio for “hav[ing] now placed relevant and updated information into the record.”^{5/} In terms of operational and administrative requirements, NAB asks that the Commission require DARS service providers to file technical information on any deployed repeaters, including antenna location and height, transmit power, and prediction of estimated coverage area. NAB Comment at 2. According to NAB, such a record-keeping requirement would enable interested parties to confirm that repeater transmissions are neither causing interference to other services nor including locally originated material. *Id.* at 2. In addition, NAB asks the Commission to require that DARS repeaters be used only to retransmit material fed to them by licensed DARS satellites, and reiterates that the Commission should adopt its proposed prohibition on the use of repeaters for local program origination. *Id.* at 3-7.

Both WCA and BellSouth, a Multichannel Multipoint Distribution Service (“MMDS”) and WCS licensee, urge the Commission to adopt a set of operational restrictions and administrative procedures in order to protect MMDS and ITFS licensees from alleged

^{4/} Supplemental Comments of Sirius Satellite Radio, IB Docket No. 95-91 (January 18, 2000).

^{5/} Comments of the National Association of Broadcasters, IB Docket No. 95-91, at 1 (February 22, 2000) (“NAB Comments”).

interference from DARS terrestrial repeater operations.^{6/} Specifically, they request that the Commission impose the following rules to DARS terrestrial repeaters:

- (1) The limitation of DARS terrestrial repeaters to an EIRP of no greater than 400 watts/MHz (according to WCA and BellSouth, an EIRP equivalent to the 2 kW EIRP limit applied to fixed WCS licensees, but adjusted to reflect bandwidth differences)
- (2) The requirement that repeater licensees provide notice to MMDS and ITFS licensees operating in reasonable proximity of their repeaters, at least 30 days before commencing repeater transmissions
- (3) The requirement that DARS terrestrial repeater licensees compensate MMDS/ITFS systems for the replacement of block downconverters, if the following conditions are satisfied:
 - (a) the interference complaint is received by the DARS licensee prior to February 20, 2002;
 - (b) the MMDS/ITFS downconverter was installed prior to August 20, 1990;
 - (c) the DARS repeater transmits at 50 or more watts EIRP;
 - (d) the MMDS/ITFS downconverter is located within a DARS transmitter's -34 dBW/m² power flux density contour (BellSouth requests a -42 dBW/m² power flux density contour;
 - (e) the MMDS/ITFS customer or licensee has informed the DARS licensee of the interference within one year from the initial operation of the repeater transmitter or within one year from any subsequent power increase.

WCA Comments at 4-5; BellSouth Comments at 3.

WCA and BellSouth argue that the same rules and restrictions that were adopted in the WCS rulemaking proceeding in 1997 should be applied to the operation of DARS terrestrial

^{6/} Comments of the Wireless Communications Association International, Inc., IB Docket No. 95-91 (February 22, 2000) ("WCA Comments"); Comments of BellSouth Corporation and BellSouth Wireless Cable, Inc., IB Docket No. 95-91 (February 22, 2000) ("BellSouth Comments").

repeaters.²⁷ They allege that DARS terrestrial repeaters operating at proposed power levels within the vicinity of subscriber equipment currently used in MMDS and ITFS systems will result in “block downconverter overload” interference in such equipment. WCA Comments at 3; BellSouth Comments at 5-6. WCA notes that Sirius Radio’s technical showing in its Supplemental Comments indicates that there is potential for such “in-band” interference at wireless cable receiver locations within 2048 meters of a terrestrial repeater. WCA Comments at 4. WCA and BellSouth argue that the proposed permanent 400 watts/MHz power limit for repeaters is necessary to give wireless cable receiver manufacturers a definite target as they move forward with the design and construction of more interference-resistant block downconverters. Citing the Commission’s finding that new filters cannot be economically installed in MMDS/ITFS equipment, WCA and BellSouth contend that the equipment compensation policy adopted in the WCS context is also necessary in the DARS repeater context. WCA Comments at 4-5; BellSouth Comments at 7-9.

In addition to the restrictions identified above, BellSouth asserts that the out-of-band emissions limit adopted for DARS terrestrial repeaters should be consistent with the repeater power limit proposed by it and WCA. Specifically, BellSouth argues that an EIRP limitation of 400 watt/MHz will result in a 14 dB improvement in the out-of-band performance of terrestrial DARS transmitters. BellSouth Comments at 9-10. To ensure that the benefits from that improved performance are enjoyed by MMDS, ITFS, and WCS licensees, BellSouth proposes that the Commission require repeater out-of-band emissions be attenuated 14 dB beyond the

²⁷ WCA Comments at 2; BellSouth Comments at 2 (citing Memorandum Opinion and Order, Amendment of the Commission’s Rules to Establish Part 27, the Wireless Communications Service, GN Docket No. 96-228, 12 FCC Rcd 3977 (1997) (“*WCS Order*”).

attenuation proposed by XM Radio and Sirius Radio ($75 + 10 \log(p)$ dB) in their supplemental comments. *Id.*

Discussion

I. XM is willing to accept a requirement that it notify the FCC of repeater locations, but no prior coordination should be required

As indicated above, NAB requests that DARS licensees be required to file with the Commission certain technical and locational information regarding each of their terrestrial repeaters. XM Radio does not oppose this proposal, as long as this requirement is in the context of a blanket licensing process and such filings are not a precondition to receipt of such license. This requirement would not be overly burdensome for XM Radio, since it will likely hold such technical data prior to commencing operations.

XM Radio does oppose, however, the proposal of WCA and BellSouth that the Commission apply to DARS licensees the same notification obligations currently applicable to WCS operators.^{8/} This requirement is unnecessary, given the evidence presented by XM Radio below that its planned DARS terrestrial repeaters do not pose a substantial threat of interference to MMDS/ITFS operations. Even if the Commission concludes that DARS repeaters are a potential interference threat to wireless cable reception, this notification requirement should not be imposed on DARS licensees in any case. This obligation would be much more burdensome for DARS operators than for WCS licensees, because DARS operators are national licensees and XM Radio, for instance, would be required to identify and notify potentially affected licensees in at least seventy markets around the country. If the Commission adopts NAB's filing

^{8/} Comments of BellSouth, at 7; Comments of WCA, at 4-5. Under the Commission's Part 27 rules, WCS operators are required to notify neighboring MMDS/ITFS licensees at least 30 days prior to commencing operations. 47 C.F.R. § 27.58(e).

requirement, such notification would be unnecessary, since interested parties such as MMDS and ITFS licensees could simply access the Commission's files to obtain all necessary information regarding the location and technical parameters of deployed DARS repeaters.

II. WCA and BellSouth have failed to present sufficient evidence to justify the imposition of their proposed rules and restrictions on DARS licensees at this late date

WCA and BellSouth fail to present sufficient evidence to justify the imposition of their proposed rules and restrictions on operators of DARS terrestrial repeaters. Rather than offer a showing demonstrating that the planned DARS repeater operations, specifically, are a potential source of interference to MMDS and ITFS reception, WCA and BellSouth rely exclusively on the Commission's decision in the WCS rulemaking proceeding and the inadequate evidence that was presented approximately three years ago in that proceeding.

A. The Commission's decision to adopt power limits in the WCS proceeding is irrelevant to the DARS repeater rulemaking

The Commission's imposition of a 2 kW power limit on WCS operators does not justify a decision to adopt the same power limit for DARS terrestrial repeaters. The WCS limit resulted not from any specific finding that WCS transmissions above that power level would cause interference to wireless cable reception, but was instead based on several factors that carry little weight in the instant context.

A key difference is that no WCS proponent was proposing to operate at power levels greater than 2 kW (*WCS Order* at para. 13), whereas here both XM Radio and Sirius Radio have been proposing to operate their repeaters at higher power levels since at least 1997. In the WCS proceeding, the Commission found that a 2 kW power limit would neither limit the WCS

licensees' operational flexibility nor impose significant costs on these licensees.^{2/} *Id.* In contrast, XM Radio and Sirius Radio are both planning to operate terrestrial repeaters well in excess of this 2 kW limit, and, as described in detail below, adoption of a 2 kW limit here would result in substantial additional costs for XM Radio. This distinction weighs heavily against application of such a limit in the repeater context.

In the WCS proceeding, the Commission was concerned less with the level of power permitted for WCS operations than it was with making sure that *some* power limit was established, so that wireless cable equipment manufacturers would have the technical certainty necessary to design an interference-resistant block downconverter. *WCS Order* at para. 13. Three years later, the new block downconverters that resulted from that redesign process are now available. As discussed below, XM Radio understands that these new downconverters have been widely deployed in major metropolitan areas around the U.S. These downconverters have filters that are sufficient to protect against interference from the proposed DARS repeaters.

In adopting the WCS power limit, it was also the Commission's intention to maintain parity between potentially competing service providers. Specifically, the Commission noted that wireless cable service was one potential use of WCS spectrum, and that the maximum EIRP for those services is also 2 kW. *WCS Order* at para. 13. This concern is irrelevant to the DARS repeater context, since DARS licensees will not be providing wireless cable service or otherwise competing directly with MMDS and ITFS licensees.

^{2/} Prior to the *WCS Order*, WCA argued that the Commission should impose a power limit of 20 watts EIRP on WCS licensees. While WCS interests opposed this proposal, no prospective WCS licensee indicated that it would be operating at power levels approaching 2 kW. The *WCS Order* noted that WCS operations at such a power level would be difficult given the considerable economic cost of developing high-power transmitters that could comply with the relevant out-of-band emissions standard. *WCS Order* at para. 13.

B. The record in the WCS proceeding is now stale, given the events that have occurred since the close of that rulemaking

The technical record in the WCS proceeding is now stale, and that record cannot serve as a legitimate basis for the imposition of a similar policy in the DARS context. It is XM Radio's understanding that, since the close of the WCS rulemaking, the technical issues raised by WCA and BellSouth in that proceeding have been substantially altered by the rollout of Personal Communications Systems ("PCS") in metropolitan areas around the United States. PCS licensees, many of which were authorized in 1995, operate in the 1930-1990 MHz band, and PCS providers are now offering service in most urban areas as an alternative to cellular licensees. For the technical reasons described in the attached Technical Appendix, PCS systems operating in the same markets as older MMDS and ITFS receivers are likely to cause widespread interference to those receivers. XM Radio understands that, as a result of such PCS operations, many MMDS and ITFS operators have chosen to replace older equipment with newer filtered downconverters.^{10/}

As demonstrated by XM Radio's technical analysis, discussed below, the new, more robust MMDS and ITFS receivers are highly resistant to transmissions at the levels being

^{10/} The widespread replacement of older wireless cable block downconverters is discussed in an article, "Conifer Concludes Implementation of Brickwalled Filtered MMDS Downconverters," available at Conifer Corporation's (www.conifercorp.com) web site. This article states the following:

The manufacturers of MMDS receivers have improved the technology to provide protection against interference. The brickwall concept originated in the late 1980's as the de-facto standard for MMDS downconverters. However, as the market for analog wireless video services grew in rural geographies, so did the availability of low noise downconverters from a number of off-shore manufacturing companies. Problems began to arise in 1996 with the rollout of PCS systems nationwide. These high-powered systems wreaked havoc with many of the existing installed low noise downconverters and resulted in substantial retrofits for a number of operators.

proposed for DARS repeaters.

C. The Commission should not adopt a proposal presented at this late date in this rulemaking proceeding

WCA and BellSouth have presented their proposed power restrictions on DARS terrestrial repeaters extraordinarily late in this pending rulemaking proceeding. The Commission's *FNPRM* was issued in March 1997, and the initial comment round on repeater issues closed in June 1997. In November 1997, both XM Radio and Sirius Radio submitted filings with the Commission describing their planned terrestrial repeater operations. In its filing, XM Radio indicated that it planned to operate terrestrial repeaters at an EIRP of up to 10 kW. Comments and replies on those supplemental submissions were filed in December 1997 and January 1998. Neither WCA nor BellSouth filed comments during either of these pleading rounds.

Clearly, WCA and BellSouth were on notice that XM Radio planned to operate higher power terrestrial repeaters. They failed to express concerns at that time regarding the effects of such operations on wireless cable block downconverters, and XM Radio has since proceeded with the design and development of its repeaters under the assumption that it would be free from power limits meant to protect MMDS and ITFS reception. Given the lateness of the arguments from WCA and BellSouth, it would be unfair and inappropriate for the Commission to impose their proposed power limit on DARS repeaters operations.^{11/}

^{11/} Given the above-described differences between DARS repeater operations and WCS, XM Radio had no reason to believe that, in the absence of any comment from WCA or BellSouth, interference to wireless cable would emerge as an issue in this proceeding.

III. The proposed power limits are unnecessary and would impose undue costs on XM Radio

A. There will be no significant interference from DARS repeaters

1. High-power DARS repeater transmissions are highly unlikely to cause interference to the new, more robust wireless cable receivers

The 2 kW power limit on DARS repeater transmissions proposed by WCA and BellSouth is unnecessary to prevent interference to MMDS and ITFS operations.^{12/} As mentioned above, it is XM Radio's understanding that new, more interference resistant wireless cable receivers have been installed in significant numbers in recent years in response to the buildout of PCS. As described in the attached Technical Appendix, these new block downconverters will protect MMDS and ITFS reception from interference from even the highest power repeater -- with 20 kW EIRP -- now being contemplated by XM Radio. These "brickwall" downconverters provide filtering against transmissions in the 2305-2460 MHz band, and provide pre-LNA attenuation of at least 40 dB. Given this attenuation, and utilizing the same assumptions adopted by WCA in its technical analysis in the WCS proceeding,^{13/} XM Radio believes that it will be able to operate a 20 kW terrestrial repeater in the DARS band as close as 100 yards from the new wireless cable downconverters without any significant likelihood of forcing these downconverters into compression.

^{12/} WCA and BellSouth have indicated that DARS repeaters should be limited to 400 watts/MHz, which is the same as the 2 kW limit applied to the WCS adjusted for the differences in the bandwidths of the allocation. WCA Comments at 5; BellSouth Comments at 7. As explained in the attached Technical Appendix, the relevant factor for interference is total power received across the band, and the addition of 400 watt/MHz criteria on the waveform would be irrelevant to either protection against block downconverter overload or limitation of out-of-band emission levels.

^{13/} See Petition for Expedited Reconsideration, The Wireless Cable Association International, Inc., GN Docket No. 96-228 (March 10, 1997) ("WCA Petition").

2. XM Radio's repeaters are unlikely to interfere even with older MMDS and ITFS receivers

As explained in the attached Technical Appendix, XM Radio's planned DARS repeaters are unlikely to cause interference to even older MMDS and ITFS block downconverters. Adopting WCA's interference threshold and its worst case assumptions from the WCS proceeding (*see* WCA Petition), the required separation distance between XM Radio's repeaters and these older receivers would be approximately .28 miles for a 2 kW repeater and approximately .9 miles for a 20 kW repeater. XM Radio believes that this interference threat is greatly exaggerated. First, as shown in the attached Technical Appendix, if realistic assumptions concerning wireless cable receiver antenna pointing and polarization discrimination are applied, additional isolation is obtained and the required separation distances would be reduced significantly. In addition, given the directionality of their transmissions, XM Radio's high-power repeaters are likely to enjoy even greater isolation.

In any case, as indicated above, XM Radio plans to deploy only a limited number of high-power repeaters in its DARS network, and the probability that wireless cable receivers will be located within the required separation distances appears to be extremely low.

B. The proposed power limits would impose substantial costs on XM Radio

If the Commission applies a 2 kW power limit in the DARS repeater context, that decision would impose substantial costs on XM Radio. XM Radio has designed an optimal system that provides the necessary coverage in urban areas with the fewest possible repeaters. A 2 kW power limit would substantially increase the number of repeaters that XM Radio would have to deploy to achieve its service goals. Currently, XM Radio plans to deploy approximately 125 repeaters with a transmit EIRP greater than 2 kW. Under the proposed power limit, as

explained in the attached Technical Appendix, each of these higher power repeaters would have to be replaced by approximately five standard 2 kW repeaters, at an added cost of approximately \$45 million. If this unanticipated cost was imposed on XM Radio, it would likely have to make up for this expenditure by increasing the price of its service.

IV. The Commission should not require DARS licensees to compensate MMDS/ITFS licensees

XM Radio opposes any requirement that it compensate MMDS and ITFS licensees that claim interference from DARS repeaters. As discussed above, WCA and BellSouth have not demonstrated a significant risk that a substantial number of wireless cable customers will be adversely affected by the deployment of DARS repeaters. Moreover, the wireless cable industry has had many years already to replace obsolete equipment. Nearly three years ago, the Commission told the wireless cable industry in connection with WCS deployment that, given sufficient time, licensees should be expected to mitigate interference costs by voluntarily replacing older receivers. *WCS Order* at para. 14. By the time XM Radio begins operating its repeater network, no sooner than mid-2001, ample time will have passed for the wireless cable industry to have fulfilled this responsibility.

Any reimbursement scheme would be complicated by the fact that in many cases, if a wireless cable customer complains of interference, it may not be altogether clear what the source of any interference is. There will be many different users of the frequencies adjacent to wireless cable operations, all of which under unfavorable conditions can cause interference to customers using a obsolete block downconverters. In such cases, it may become unduly complex and expensive to determine objectively the source or sources of the interference, perhaps even requiring adjudication of the issue by the Commission.

If the Commission does require compensation along the lines of that which it adopted in the WCS proceeding, it should accelerate the sunset for such compensation by a year, to February 20, 2001. This will minimize the impact on DARS repeater deployment, and reflects the substantial time that wireless cable systems have had to respond to any interference threat. In addition, any compensation claims should be limited to instances in which the source of interference is a repeater operating at a power level of more than 2 kW EIRP, again since the wireless cable industry has had ample time to plan for operations at that level by WCS operators.

V. BellSouth's request for a more stringent out-of-band emissions limit should be rejected

The Commission should reject BellSouth's proposal that the Commission impose a more stringent out-of-band emissions limit than the $75 + 10 \log (p)$ dB standard agreed upon by XM Radio and Sirius Radio. As an initial matter, this proposal is predicated on the Commission's adoption of the power limit requested by WCA and BellSouth, and XM Radio has demonstrated above that such power limits are neither necessary nor appropriate. Whatever the power level for DARS repeaters, there is no technical basis for an out-of-band emissions standard that is 32 dB more stringent than the standard that BellSouth itself must meet to protect other fixed WCS licensees.^{14/} Adoption of such an extreme standard would impose a significant economic and technical burden on XM Radio by unfairly increasing the cost and complexity of its repeaters.

Moreover, as explained in the attached Technical Appendix, BellSouth's assumption that a limitation of 400 watts/MHz will result in a 14 dB improvement in repeater out-of-band emissions performance is not valid, and BellSouth has not established any reason why a different

^{14/} Under the Commission's Part 27 rules for WCS, fixed licensees in that service must meet an out-of-band emissions limit of $43 + 10 \log (p)$ dB on all frequencies between 2300 and 2320 MHz and 2345 and 2370 MHz that are outside those licensees' licensed bands of operation.

out-of-band emissions level should be established for repeaters with different power levels.

Conclusion

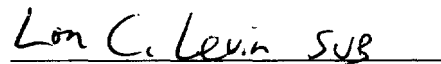
In light of the foregoing, XM Radio Inc. requests the Commission to expeditiously finalize its rules for DARS terrestrial repeater facilities and permit XM Radio to move forward with the rapid implementation of its satellite DARS network.

Respectfully submitted,

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TECHNICAL APPENDIX

ANALYSIS OF TECHICAL ISSUES RAISED BY WCA AND BELLSOUTH

In their comments, the Wireless Communications Association International ("WCA") and BellSouth Corporation and BellSouth Wireless Cable, Inc. ("BellSouth") seek various rules and restrictions with respect to the operation of DARS terrestrial repeaters. This Technical Appendix addresses several technical issues raised by these filings.

1. Newer MMDS/ITFS receivers are highly resistant to interference

The new MMDS receivers are substantially protected against interference from DARS repeater emissions. The new MMDS downconverters provide filter characteristics that reduce the susceptibility to transmissions in 2305-2460 MHz band. These "brickwall downconverters" provide pre-LNA attenuation of out-of-band signals of 40 to 60 dB.¹ The attenuation characteristics of these new MMDS systems can be examined at the Conifer Corporation (www.conifercorp.com/frameprd.htm) and California Amplifier (www.calamp.com/Products/Wireless/MMDS_Video_and_Scrambling/mmlds_video_and_scrambling.htm) web sites. With these filter attenuation parameters, it is possible to calculate the power threshold at which an XM Radio terrestrial repeater will cause interference to an MMDS installation:

Assumptions

MMDS receiver input level for 1 dB compression with margin = -16 dbm
Gain of MMDS receive antenna = 24 dBi
Distance of an MMDS receiver from an XM repeater = 100 yards
XM transmitter frequency = 2340 MHz
Pre-LNA attenuation = 40 dB

Calculation

Maximum EIRP of XM Radio transmitter without causing interference to an MMDS installation
=

$$\begin{aligned}\text{EIRPmax} &= -16 + (20 \log (100/1760) + 20 \log (2340) + 36.8) + 40 - 24 \\ &= -16 + (-24.91 + 67.38 + 36.8) + 40 - 24 \\ &= 79.27 \text{ dBm}\end{aligned}$$

¹ The term brickwall denotes a technology that uses an interdigital style mechanical bandpass filter, which offers extremely sharp skirts with low insertion loss. The result is a high performance, low noise pre-LNA filter for protection against external sources of interference.

This analysis demonstrates that XM Radio can operate a 20 kW terrestrial repeater in the DARS band and not force the new MMDS downconverters into compression even when that MMDS equipment is less than 100 yards away from the repeater.

2. It is unlikely that DARS repeaters will cause interference to older MMDS/ITFS block receivers

Equipment manufacturers have indicated that block downconverter overload in MMDS/ITFS receivers can occur if the cumulative energy received in-band is greater than -6 dBm. *See* Petition for Expedited Reconsideration, The Wireless Cable Association International, Inc., GN Docket No. 96-228 (March 10, 1997) (attaching Letter from Pacific Monolithics, dated March 1, 1997). Given this parameter, one can calculate the required separation distance needed to protect these older converters from such an emission under varying geometries between the transmitter and the receiver. Usually, the calculations are performed assuming a worst-case scenario in which the victim receiver antenna is pointed directly at the transmitting antenna and there is a clear line-of-sight path between the two units.

Assumptions

MMDS receiver input level for 1 dB compression = -6 dBm (-36 dBw)

Gain of MMDS receive antenna = 24 dBi

XM transmitter frequency = 2340 MHz

Calculation

Minimum distance of XM Radio transmitter without compressing MMDS installation =

$$\text{Dist(miles)} = \text{EIRP} + 36 - (20 \log (2340) + 36.8) + 24$$

Under worst-case assumptions, the separation distance between an MMDS receiver and a 2 kW DARS repeater is approximately .28 miles, while the separation distance between an MMDS receiver and a 20 kW transmitter is approximately .9 miles. This calculation does not take into account a more realistic scenario where the antenna is not directly pointing to the XM Radio repeater, nor does it take into account any polarization isolation. As shown below, however, such worst-case scenarios are highly improbable, and more realistic separation distances will be much smaller.

XM Radio will be locating its repeater transmitting antennas in elevated locations in order to maximize the coverage area for any given site. MMDS receive locations use directional antennas that peak their gain in the direction of the MMDS transmission site. Whenever the XM Radio and MMDS transmitting antennas are not collocated, the MMDS receive location will be provided some amount of antenna discrimination towards the XM Radio transmission site that will attenuate the total amount of interference actually received. The amount of this attenuation can be as high as 20 dB. Even with as little as 5 dB discrimination, the separation distances for 2 kW and 20 kW transmitters are reduced to .15 and .5 miles, respectively. Thus, the off-pointing

of MMDS antennas away from the XM Radio transmitting antenna provides protection for even the older analog MMDS downconverters, a factor that WCA has not taken into account. Significantly, XM Radio is unlikely to collocate its antenna on the same tower as has an MMDS operator.

XM Radio's high-powered transmitter sites characteristically use sectored antennas that direct transmissions towards areas that suffer from a high incidence of satellite line-of-path blockage. These antennas produce an EIRP of 20 kW in the sector that is being covered by the repeater site, but little energy in other directions. The front-to-back ratio of XM Radio's sectored antennas is 15 dB. As a result, even in the vicinity of one of XM Radio's high-powered transmitters, there are large areas in which an old analog MMDS receiver can be as close as .15 miles (158 yards) to a transmitter and not be seriously affected by XM Radio's transmissions.

Besides antenna discrimination, many MMDS receivers would be provided protection by polarization discrimination. Both the XM Radio terrestrial repeaters and the MMDS systems use linear polarization. XM Radio terrestrial repeaters will use vertical linear polarization. As a result, any MMDS receiver antenna which has a mainbeam pointed towards the XM Radio terrestrial repeater and is tuned to receive horizontally polarized signals will be provided 30 dB of polarization discrimination, in addition to attenuation from propagation loss. Antennas that are not pointed directly at the XM Radio terrestrial repeater location will receive some additional protection from polarization discrimination, but it will vary depending on the angle of arrival.

Antenna and polarization discrimination are two parameters not considered by WCA or BellSouth in their evaluation of the interference potential from the planned XM Radio terrestrial repeaters. These factors help isolate the MMDS receivers from the effects of the XM Radio terrestrial repeater transmissions and reduce the separation distance required between the transmit and receive sites.

3. PCS is a more likely source of interference to older MMDS/ITFS receivers

Personal Communications Service ("PCS") systems provide cellular-type service in most urban areas in the 1930-1990 MHz band. In metropolitan areas in which PCS systems and MMDS and ITFS systems both operate, PCS emissions are likely to cause interference to older MMDS receivers. These early block downconverters do not filter out signals in the PCS band, which are the "image frequencies" of the channels in the 2500-2686 MHz band. For instance, a local oscillator tuned to 2278 MHz would convert both the 2500 and 1900 MHz to a frequency around 200 MHz IF. This "dual conversion" problem is likely to cause interference to older MMDS and ITFS receivers since the PCS signals would interfere with the MMDS signals after being downconverted to an IF frequency.

4. The proposed 400 watts/MHz power spectral density limit would not make interference to MMDS/ITFS receivers less likely

WCA and BellSouth argue that DARS repeaters should be limited to 400 watts/MHz, which is the same as the 2 kW limit applied to WCS licensees, adjusted for the differences in the

bandwidths of the allocation. In the event a 2 kW EIRP limit were imposed on the DARS terrestrial repeater, the addition of 400 watt/MHz criteria on the waveform would be irrelevant to the protection of the MDS/ITFS or to the regulation of out-of-band emission levels.

According to analysis from the commenters in the WCS proceeding, the older MDS/ITFS converters are affected if the total interfering power of a transmission exceeds -6 dBm at the input to the downconverter. It does not matter how the interfering power is spread across the band, since there is little attenuation of signals provided in this section of the band; the important parameter is the total power that is received in this portion of the band by the victim downconverter, and not the nature of its distribution across that band. Thus, the proposed limit on the power spectral density in terms of watts/MHz will not provide further interference protection to the MDS/ITFS downconverters.

In addition, XM Radio has indicated that it will limit its out-of-band emissions to at least $75 + 10 \log (P)$ dB for all transmitters. This means that XM Radio will be able to limit its out-of-band emissions even when its transmitted spectral power density exceeds 400 watts/MHz. Accordingly, the proposed limit on power spectral density will not assist in the reduction of XM Radio's out-of-band emission levels.

5. There is no technical basis for BellSouth's proposed out-of-band emissions limit

BellSouth asks the Commission to impose an out-of-band emissions ("OOB") limit on DARS licensees that is 14 dB more stringent than the $75 + 10 \log (P)$ dB standard proposed in XM Radio's Supplemental Comments. As an initial matter, this proposal is predicated on the Commission's adoption of the power limit requested by WCA and BellSouth, and XM Radio has demonstrated above that such power limits are not necessary to protect MMDS/ITFS receivers from interference.

Notwithstanding the power level for DARS terrestrial repeaters, there is no technical basis for such a stringent out-of-band emissions standard for these facilities. This proposed standard is 32 dB more stringent than the standard that BellSouth itself must meet to protect other fixed WCS licensees ($43 + 10 \log (p)$). This standard would impose a significant economic and technical burden on XM Radio by unfairly increasing the cost and complexity of its repeaters.

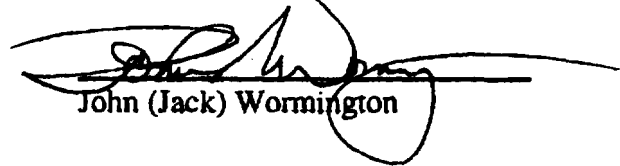
BellSouth's position is based on the assumption that a limitation of 400 watts/MHz will result in a 14 dB improvement in the OOB performance. This assumption is invalid. Consistent with a cost-effective approach to repeater deployment, XM Radio employs different kinds of hardware for repeaters with different power levels. XM Radio's repeater hardware is optimized to meet the OOB performance criteria. XM Radio's 2 kW repeaters will differ from its 20 kW repeaters with respect to various technical parameters. In particular, the OOB performance for each repeater will vary relative to the total power but will result in the same power density for all repeaters. (All of XM Radio's repeaters will comply with the $75 + 10 \log (P)$ dB limit agreed upon by XM Radio and Sirius Satellite Radio Inc.) As a result, the 14 dB reduction in EIRP that results from using a 2 kW repeater will not automatically result in a 14 dB reduction in OOB

levels, as BellSouth assumes.

Technical Certification

I, John (Jack) Wormington, Senior Vice President, Engineering and Operations of XM Satellite Radio Inc. ("XM Radio"), hereby certify the following under penalty of perjury:

I have reviewed the foregoing "Consolidated Reply of XM Radio Inc." and supervised the preparation of the foregoing "Technical Appendix," and the technical information contained in these materials is true and correct to the best of my belief.



John (Jack) Wormington

Dated: March 8, 2000

CERTIFICATE OF SERVICE

I, Marilyn Murphy , a secretary to the law firm of Fisher Wayland Cooper Leader & Zaragoza L.L.P., hereby certify that on this 8th day of March, 2000, I served a true copy of the foregoing **"CONSOLIDATED REPLY OF XM RADIO, INC."** by first class United States Mail, postage prepaid, upon the following:

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